CALTRANS REGIONAL OPERATIONS FORUMS

Advanced Corridor Operations Techniques

How Travelers Use a Corridor

- Travelers view the transportation network as a whole
- When faced with congestion on one facility, travelers may respond by
  - ↳ Selecting a different facility (transit or roadway),
  - ↳ Adjusting their trip to another time of day, or
  - ↳ Remaining on their current route
- Should we manage the corridor to reflect how travelers use it?

Corridor Management

- Corridors offer opportunities to operate and optimize the entire system
  - Beyond individual networks
- Transportation corridors often contain unused capacity
  - Parallel routes
  - Non-peak direction
  - Single-occupant vehicles
  - Underutilized transit services
- Managing the corridor can more fully utilize this capacity
  - Management approaches like ramp metering
  - Traveler information and outreach

Active Traffic Management

What Is Active Traffic Management?

Traffic management concepts intended to:

- Enhance roadway safety
- Reduce congestion
- Provide reliable trips
- Provide enhanced information to motorists
- Leverage available capacity during periods of congestion or incidents

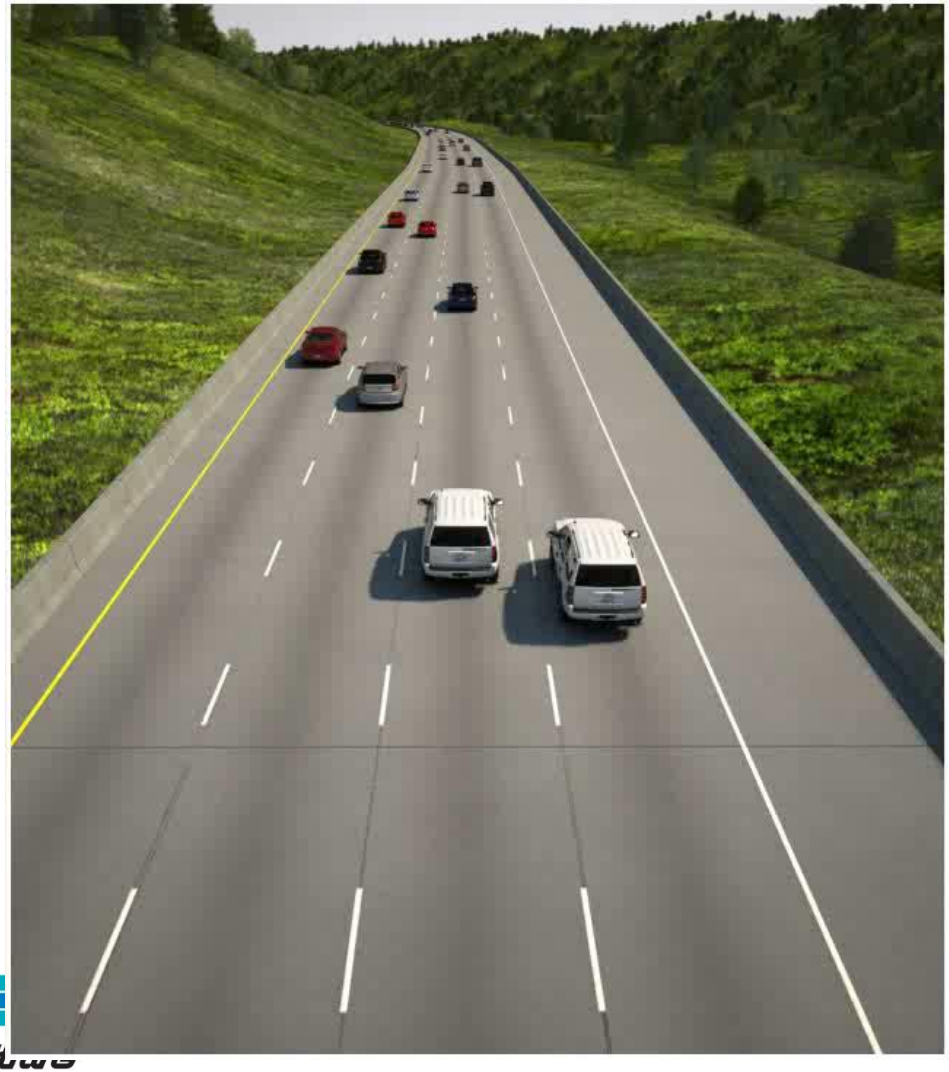
M 42 Speed Harmonization and hard shoulder lane in England. (UK Highways Agency)

Examples of ATM

- Lane-use control
- Variable speed limits / advisories
- Queue warning
- Hard shoulder running
- Dynamic re-routing
- Junction control
- Adaptive ramp metering

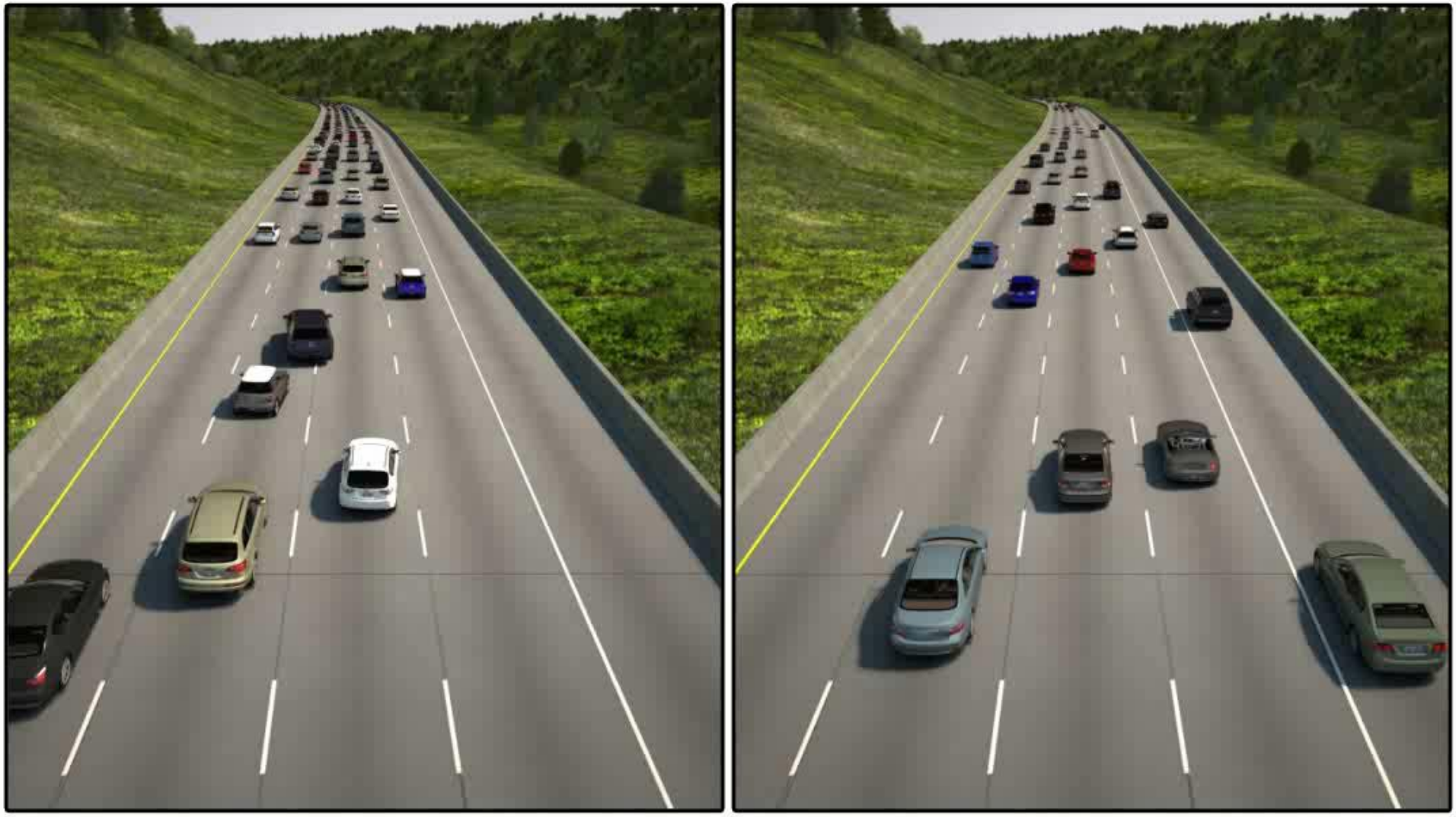
Active Traffic Management is not limited to urban areas!

ATM Simulation



Active Traffic Management Simulation

Scenario 3: Two-Lane Incident Closure with Congestion



Active Traffic Management Simulation

Scenario 5A: Add Lane To Drop Lane - Closed

PARSONS BRINCKERHOFF

Scenario 6A: Add Lane and Drop Lane - Open

Examples of ATM in the US

- Seattle
- Minneapolis
- I-66 (Northern Virginia)
- Los Angeles
- Dallas “Horseshoe”
- Denver
- Utah I-80 Parley’s Canyon
- I-80 (SF Bay Area)
- New York Long Island Expressway
- Philadelphia I-95
- Portland, OR
- New Jersey
- I-80 Wyoming
- Others?

Many examples in Europe and around the world!

Variable Speed System on Rural Corridors

I-80 in Wyoming

I-80 in Utah, Parley's Canyon

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Wyoming I-80

- AADT 11,000
- <50% of I-80 traffic is heavy trucks

Significantly reduced crashes for trucks and other vehicles

ATM in I-80 Corridor

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WSDOT's Smarter Highways

- Variable speed limits, lane control, traveler information
- Reduce speeds approaching congestion, crashes, work zones
- Warn motorists of downstream queues
- Display which lanes are open, closed, and closed ahead
- Primary objective is safety improvement

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ATM in Action in Seattle Area

The Use of ATM is Expanding

- ATM has moved beyond stand alone implementations
- ATM is compatible with other combined, integrated approaches
  - Traffic incident management
  - Work zone traffic management
  - Managed lanes

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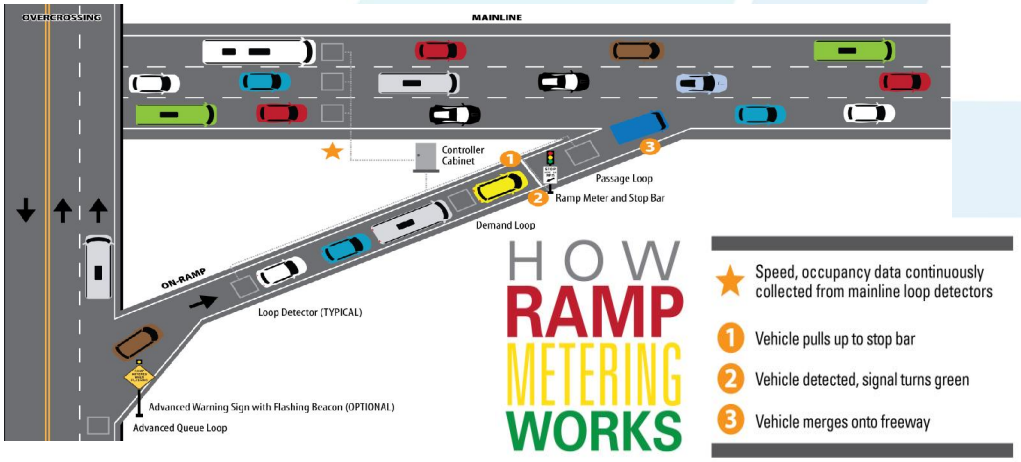
Ramp Metering

- Reduces overall freeway congestion by managing the amount of traffic entering the freeway and by breaking up platoons
- Algorithm determines entrance rate based on mainline volume, speed, queue length
  - Objective is to limit the amount of traffic entering freeway to minimize flow breakdown
- Widely used throughout California
- What about the 99 Corridor?



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Ramp Metering Benefits

- Mobility, Reliability, and Efficiency
  - Reduced travel times
  - Increased travel time reliability
  - Increased mainline speeds
- Safety
  - Crash reduction
- Reduced Environmental Impacts
  - Reduces stop-and-go conditions
  - Less fuel consumed
- Low cost with High Benefit/Cost Ratio
  - Cost effectiveness
  - Twin Cities metering had B/C ratio of 15 : 1
- Probably the most proven freeway management strategy
  - Leverage ITS infrastructure
  - Reduced environmental documentation

Central Ramp Metering Algorithms

- Newer algorithms are “adaptive”
  - Dynamically control rate of vehicles entering freeway
  - Traffic responsive/adaptive to optimize conditions
  - Uses Real-time/anticipated traffic conditions
- Examples
  - Stratified Zone – balances traffic entering and exiting zone
  - Fuzzy Logic – rules based, mainline and ramp conditions
  - HERO – estimates queues, dynamic critical occupancy
  - SWARM – based on forecast, current, saturation densities
  - CARMA – speed based algorithm

Benefit/Cost Analysis

Table ES.1 Annual Benefits of the Ramp Metering System (Year 2000 Dollars)

Performance Measure	Annual Benefit	Annual $ Savings
Travel time	25,121 hours of travel time saved	$247,000
Travel time reliability	2,583,620 hours of unexpected delay avoided	$25,449,000
Crashes	1,041 crashes avoided	$18,198,000
Emissions	1,161 tons of pollutants saved	$4,101,000
Fuel consumption	5.5 million gallons of fuel depleted	($7,967,000)
Total annual benefit		**$40,028,000**

- Annual cost of $2.6 Million to operate ramp meters
- 15:1 Benefit/Cost Ratio for Ramp Metering

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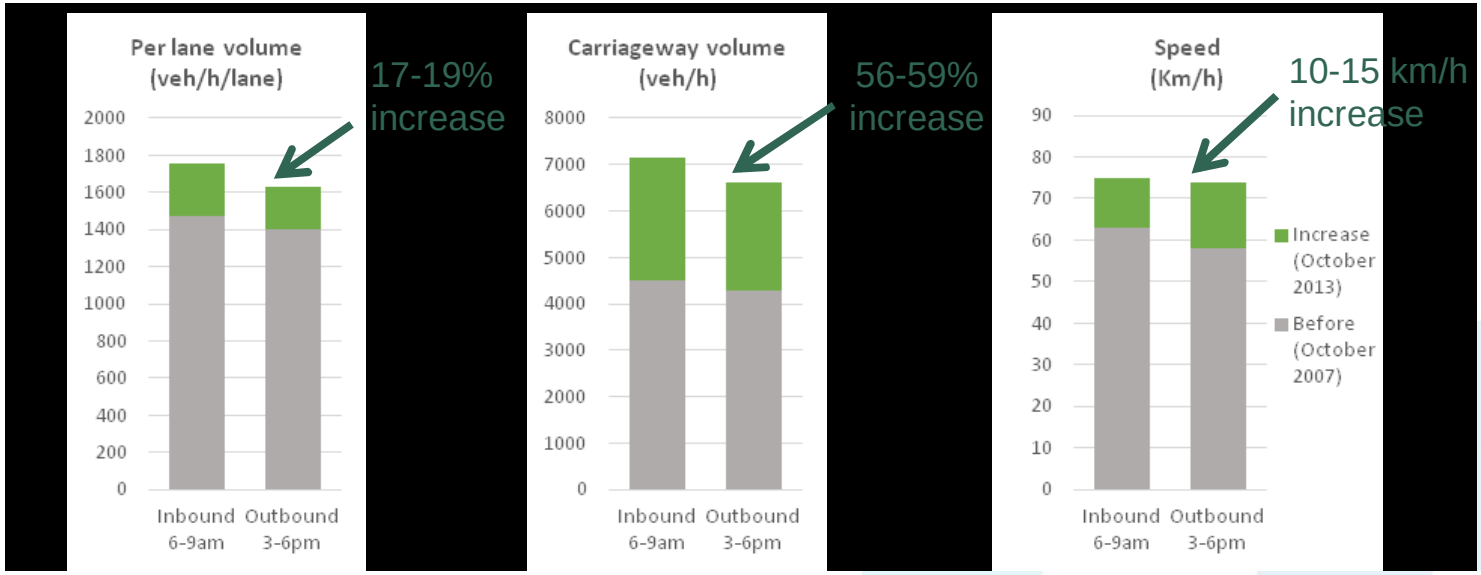
Results from Melbourne

- M1 volume and speeds have increased
  - Data compares October 2010 to October 2013 covering a 16 mile segment of freeway for all weekdays including incidents and inclement weather



Source: VicRoads

What is ODOT RealTime?

ODOT RealTime is a comprehensive system of automated technologies to improve the operations of the freeway system. Goals of this system are to provide traveler information and to improve safety and travel time reliability.

217 Benefits of Ramp Metering

The Upgraded Ramp Metering System was the first tool from the ODOT RealTime system to be implemented last year on Highway 217. The existing ramp meters throughout the corridor were upgraded to a new and improved adaptive system.

The benefits of the upgraded adaptive ramp metering system include decreasing travel times and improving travel-time reliability with no impact to vehicle throughput.

In addition to Highway 217, the upgraded adaptive ramp metering system has now been deployed throughout the Portland Metro area.

TRAVEL TIME RELIABILITY

IMPROVED BY **19%**

Commute times became 19% more consistent, making it easier to arrive on time.

TRAVEL TIME

REDUCED
13% AM
7% PM

TOTAL DELAY

REDUCED
33%

Public Perception Challenges

- Understanding of Purpose and Benefits
- Metering during congested vs non-congested time-of-day
- Comparisons to adjacent ramp conditions
  - Wait Time
  - Cycle Length
- Metering congested vs non-congested roadways

Is ATM the Right Solution?

- ATM sounds great! How do I get started?
- Important considerations:
  - What roadway networks and facilities would be best suited for ATM in my region?
  - What specific or combination of ATM strategies would work best?
  - What would be the range of expected benefits?
  - What would be the expected costs (capital and ongoing)?

Guidance Document

ATM Feasibility and Screening Guide

http://www.ops.fhwa.dot.gov/publications/fhwahop14019/fhwahop14019.pdf

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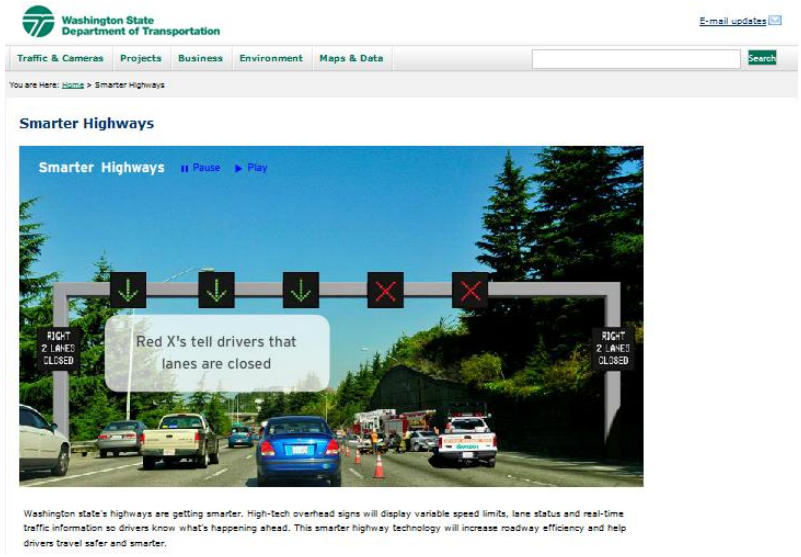
Success Factors

- High traffic volumes
- Changes in prevailing conditions
- High prevalence of crashes
- Bottlenecks
- Adverse weather
- Variability in trip reliability
- Construction impacts
- Financial constraints
- Limitation in capacity expansion

WSDOT Outreach Examples

- Smarter highways video on Youtube http://www.youtube.com/wsdot#p/u/12/cd0doR0Ga-I
- Smarter highways www.smarterhighways.com
- Posted links on Twitter, Facebook and WSDOT blog
- Outreach to cities, counties, businesses, colleges



Group Discussion

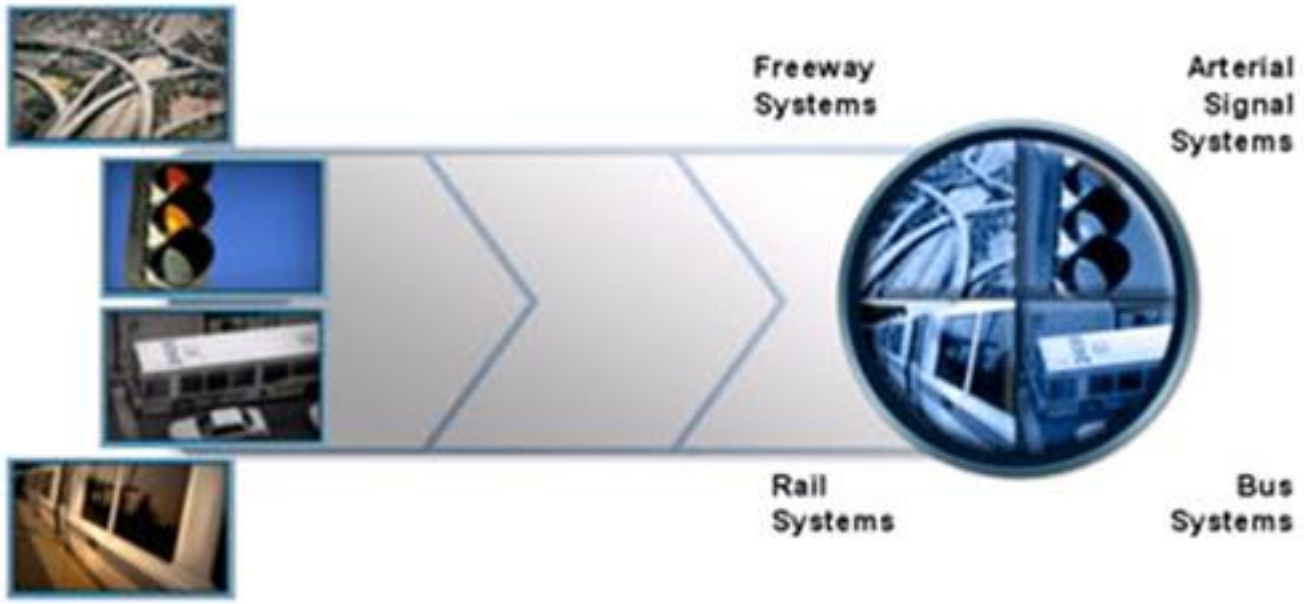
- What other examples of ATM have you heard about?
- What technologies are in use here that you would consider active traffic management?
- What types of ATM could have a positive impact on operations in the 99 corridor?

INTEGRATED CORRIDOR MANAGEMENT

Integrated Corridor Management

- ICM Background and Concepts
- Status of the Federal ICM Initiative and Sites
- Planning for ICM
  - Stakeholders
  - Integrating with existing plans and programs
  - ICM Concept of Operations
  - Agreements
  - Modeling and Performance Measures
- Integration to Support ICM Strategies

What Is ICM?



- **Maximize corridor capacity through:**
  - New institutional models
  - New technology
  - More dynamic operational strategies

USDOT ICM Initiative

ICM Pilot Sites:

- San Diego, CA
- Dallas, TX

Key Elements:

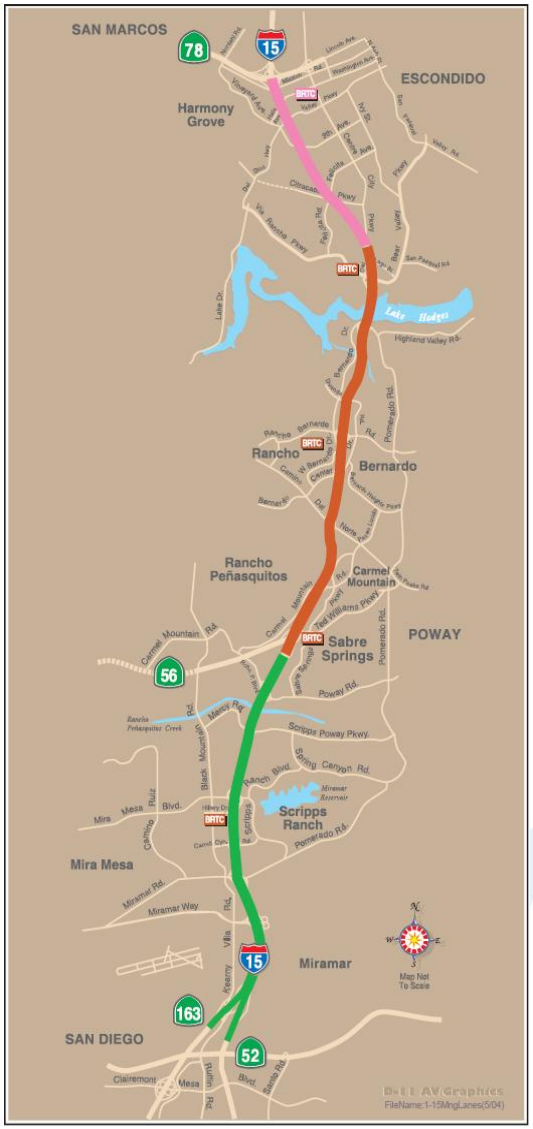
- Decision Support Systems
- Institutional Agreements
- Operational Strategies
- Multimodal

ICM Planning Grants:

- I-10, Phoenix, AZ
- I-210, LA/Pasadena, CA
- SR4, Bay Area, CA
- I-95, Broward Co., FL
- I-95/MD295/US1, Baltimore, MD
- NJ Turnpike and US1
- NYC – multiple corridors
- I-90 Buffalo-Niagra, NY
- I-84, Portland, OR
- IH-10/US-54/IH-110, El Paso, TX
- IH-35, Austin, TX
- I-15, Salt Lake City, UT
- Northern VA – multiple corridors

SANDAG I-15 ICM

- Primary artery for the movement of commuters, goods, and services from north San Diego County to downtown.
- I-15 Managed Lanes System
- Multi Institutional Cooperation/ Partnerships
- Multi-modal Transportation Improvement Strategies and Mode Shift – BRT, TSP
- 511, including transit information



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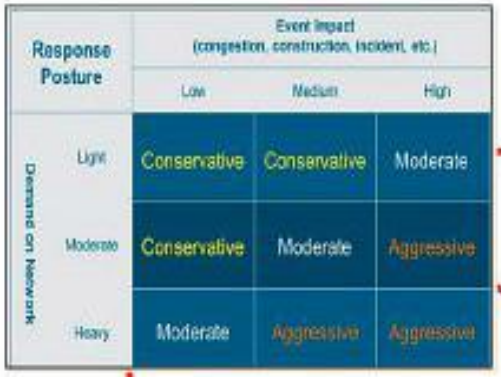
I-15 ICM Decision Support "Response Postures"



Demand

Light
- Weekends
- Holidays

Moderate
- Off-peak weekday
- Minor weekend special event

Heavy
- Peak-hour weekday traffic

Response Posture

Conservative
- Example – Provide slight increase to ramp metering rate

Moderate
- Example – Provide additional green-time to favor northbound traffic while still providing adequate cross-street timing

Aggressive
- Example – Display alternate route for freeway traffic on CSM, such as "INCIDENT AHEAD NB USE POMERADO"

Event Impact

Low
- Incident closing freeway shoulder or one lane
- Construction closing one lane of primary arterial
- Breakdown of transit vehicle

Medium
- Incident closing 1 freeway lane
- Closure of Express Lanes
- Construction on Pomerado reducing NB and SB to one lane each direction

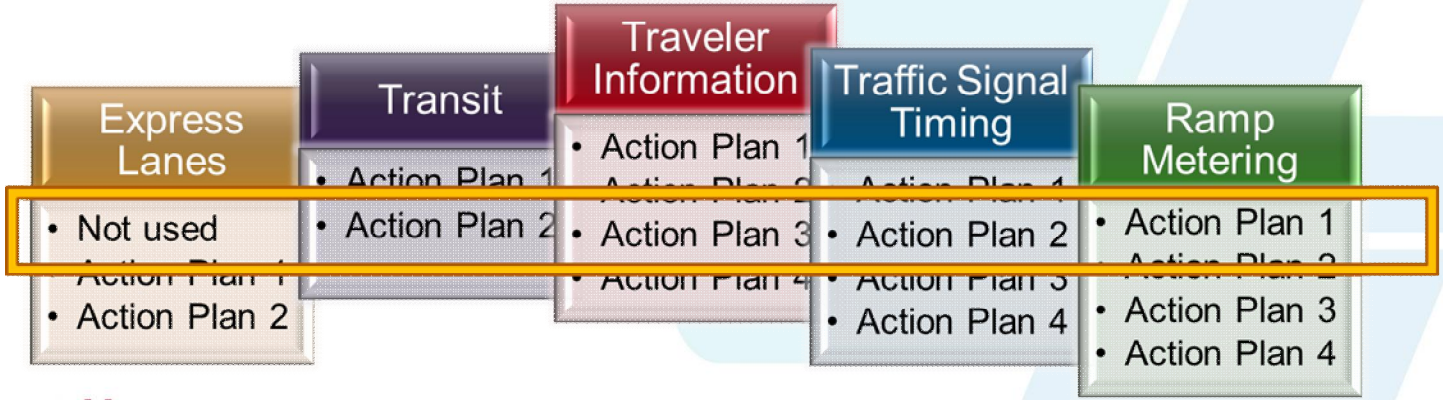
High
- Major incident at intersection of primary arterials
- Closure of two or more lanes of the freeway
- Combination of low and medium incidents

I-15 ICM Response Plans

- 156 Alternate Routes
- 260 Local Arterial Intersections
- 18 Metered Interchanges
- 20 Dynamic Message Signs
- 5 BRT stations
- 20 miles HOT – reversible lanes
- 30 miles Traffic Responsive
- 511 (including app)

Limited set of "point-in-time" Response Plans by:

- Using Asset Restrictions
- Using Availability Conditions
- Using Thresholds to select "next move" relationships
- **= 1.5 billion combinations!**



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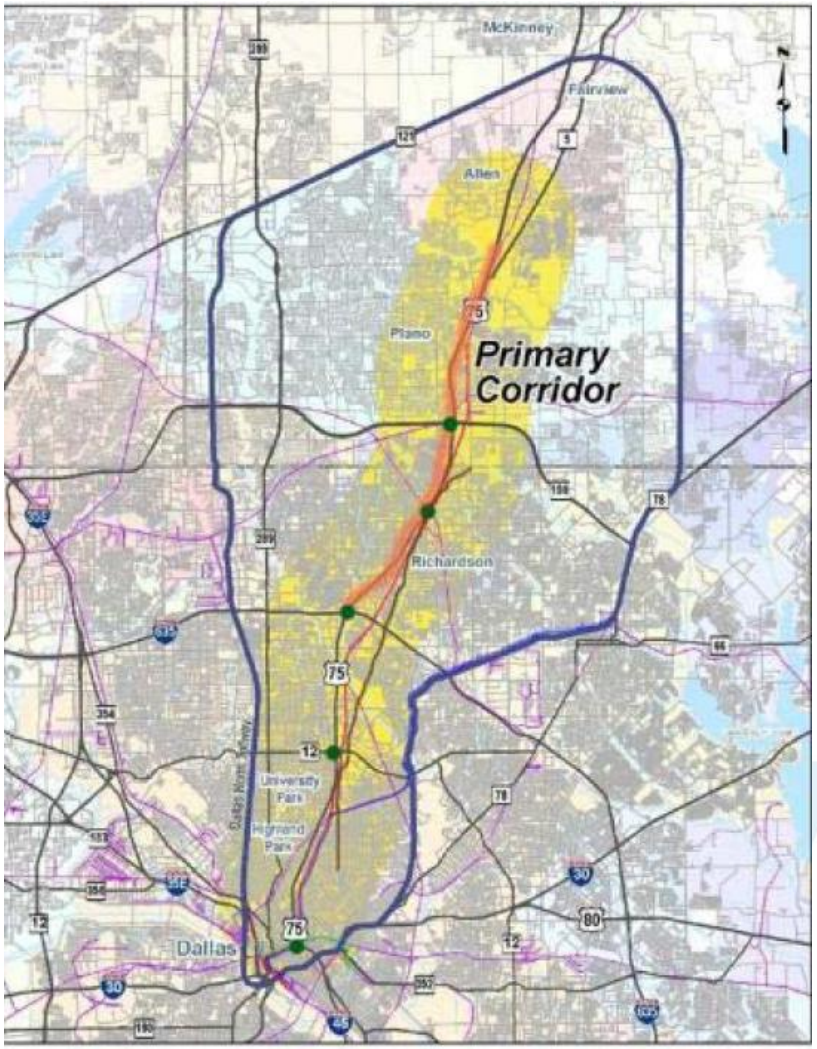
Dallas US-75 ICM

- Freeway with continuous frontage roads
- Managed HOV lanes
- Dallas North Tollway
- Arterials
- Bus Network, Light Rail
- Approx. 900 traffic signals
- Multiple TMCs
- Regional ATIS (511)



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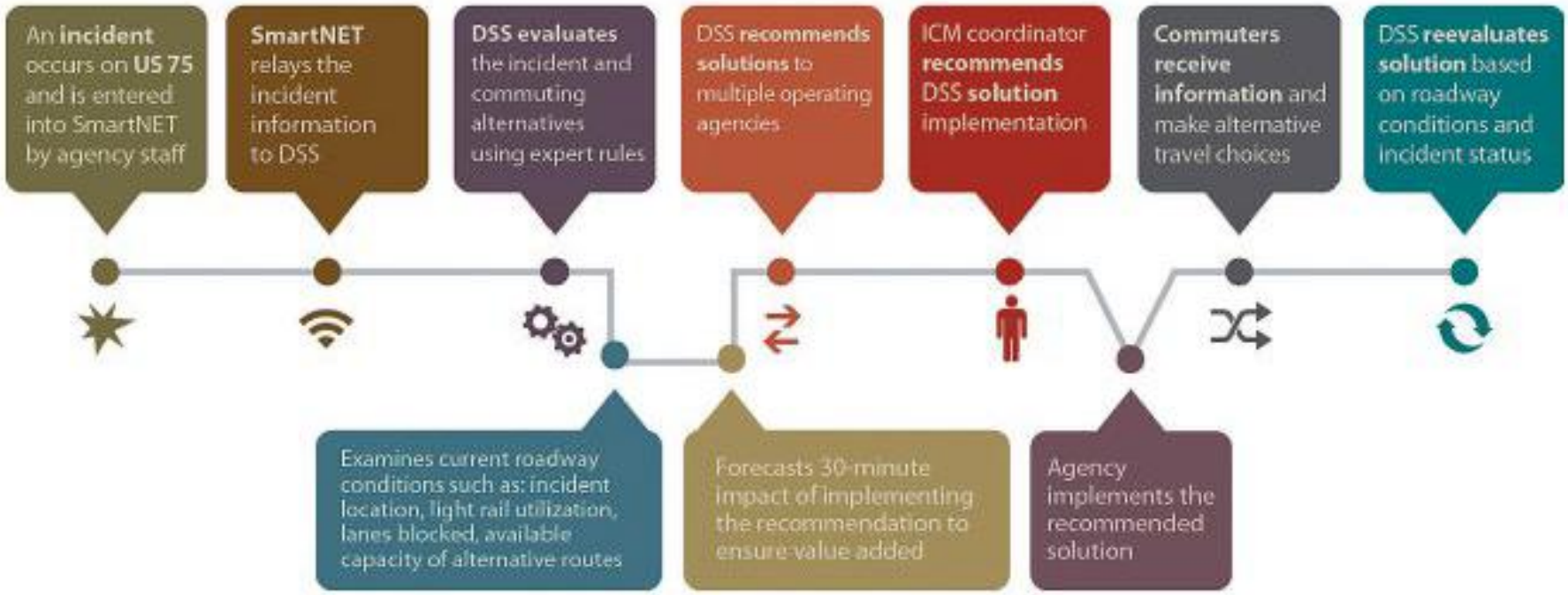
US 75 ICM Decision Support



THE BENEFITS

- **Improved travel time reliability for commuters**
- **Enhanced decision making support for operating agencies**
- **Achieves a 20:1 return ($278.8 million) on the project's cost over 10 years**
- **Less pollution from idling vehicles in congested traffic**

USDOT ICM Status Update

- San Diego and Dallas went “live” in early 2013
- Testing and evaluating the DSS in both regions (3-year evaluation)
- Independent evaluation
- Early lessons:
  - Agreements are tough. Most challenging part of ICM.
  - Data integration from multiple systems and multiple networks
  - Determining mode shift is difficult, working through how to evaluate effectiveness
  - Combinations of strategies also are challenging to evaluate

AZ Loop 101 ICM

- Arizona DOT, Scottsdale, Maricopa County, SRPMIC Tribe
- Event-driven ICM for freeway closures
- Positives:
  - Dense arterial ITS Experienced TMC staff
  - Provide arterial alt route
  - REACT to support arterial traffic diversions
- Focus on process improvements
- No new infrastructure

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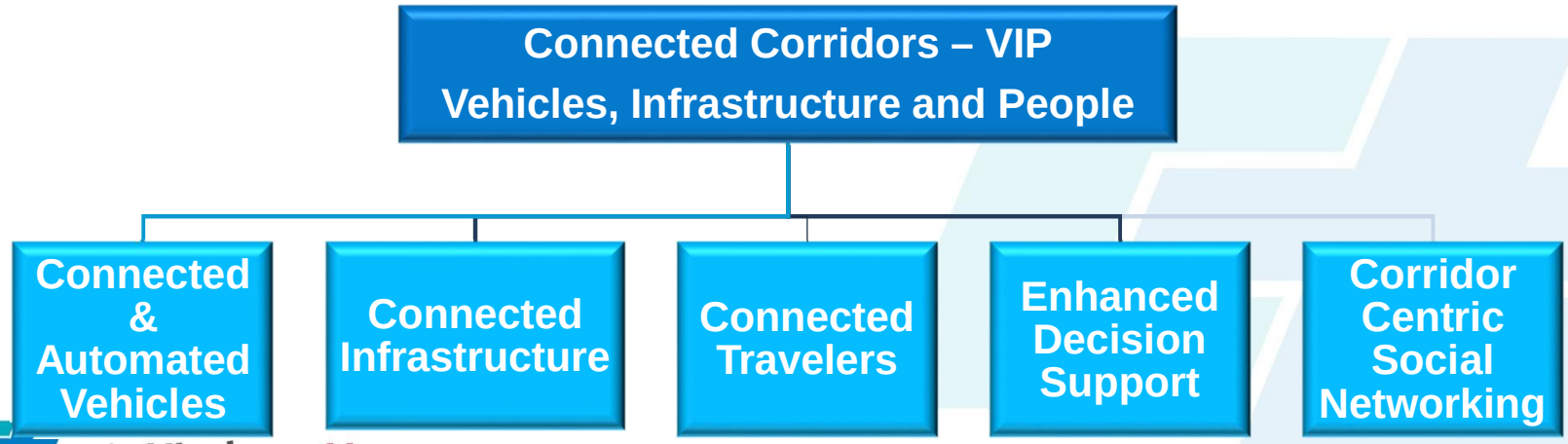
California Connected Corridors

- Initiated in 2011 – Statewide Framework
- Focus on planning, implementation, O&M
  - Implement TSM&O on their most congested corridors (50)
  - Evolve Caltrans to real-time operations and management
  - Enhance partnerships
  - Optimize infrastructure and capacity
  - Improve overall corridor performance



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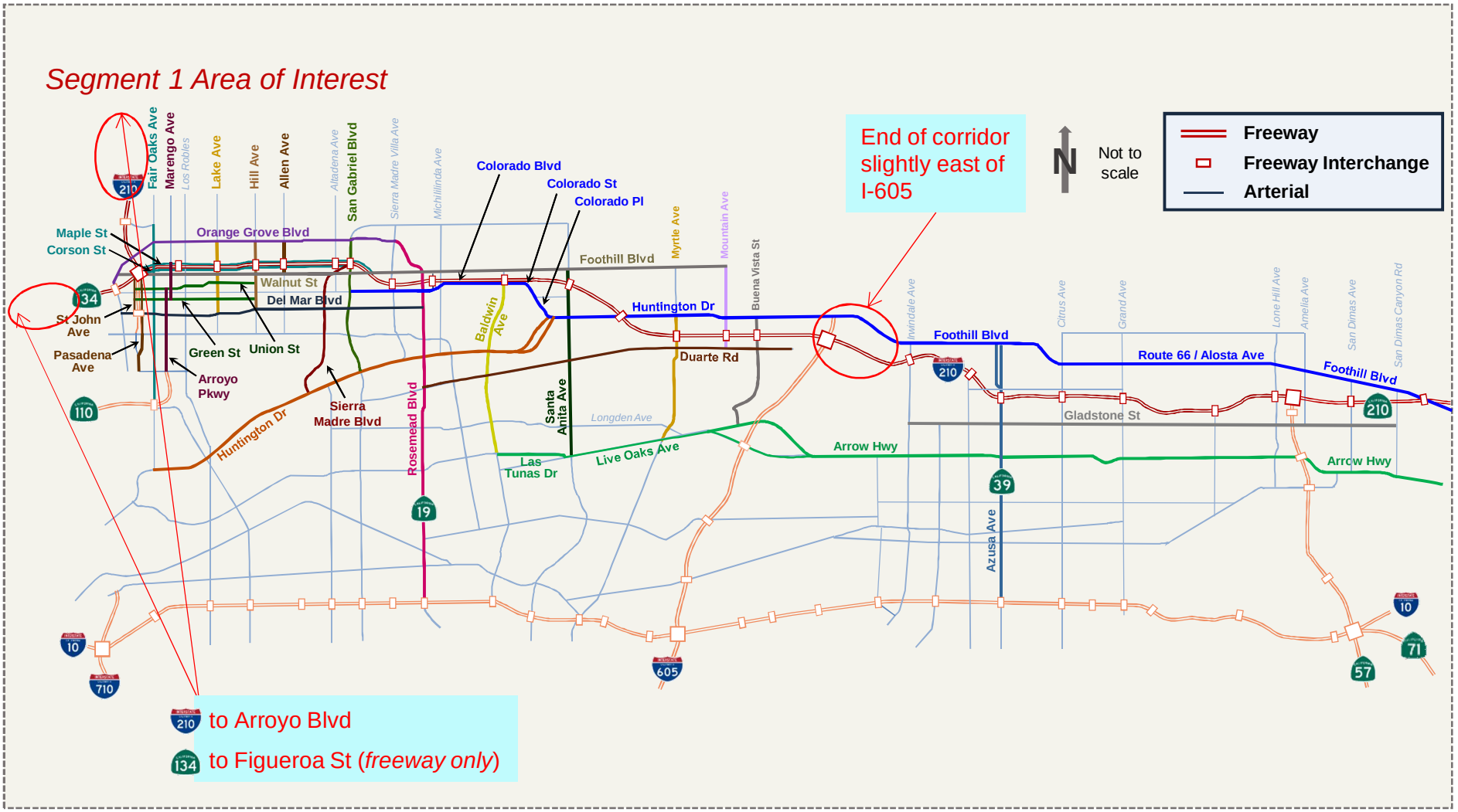
I-210 Project Corridor (Pilot)

Segment 1 Area of Interest



Stakeholder Roles for ICM

- Identifying the right partners
- Key partners
  - Freeway management and operations – TOC, freeway service patrol, freeway incident response
  - Arterial management and operations – TOC, signal operations
  - Transit
  - Incident response and management – freeway and arterial incident response/law enforcement
  - MPO – planning
  - Others to be determined on a regional level based on operational need
- ***Leadership commitment – key to sustaining partnerships. You already have this!***

Leveraging ICM

- ITS Plans or Updates/TSMO Planning
- Traffic Incident Management Coalitions
- Standing Committee Meetings (ITS Partners)
- Large-scale freeway or arterial improvement projects
- TIP funding cycles
- RTP updates
- Follow up initiatives from RCTO and other Ops Plans

Plant seeds, build interest, introduce ICM as a collaborative, regional effort

ICM Performance Measures

- National evaluation is looking at the following MOEs:
  - Vehicle and person throughput
  - Travel times and travel time index
  - Standard deviation of travel time
  - 80th, 90th, and 95th percentile travel times
  - Buffer and Planning Indices
  - Traveler Response
  - Safety benefits
- Other ICM Objectives could be…
  - Traveler information
  - TIM
  - Data sharing
  - Institutional participation

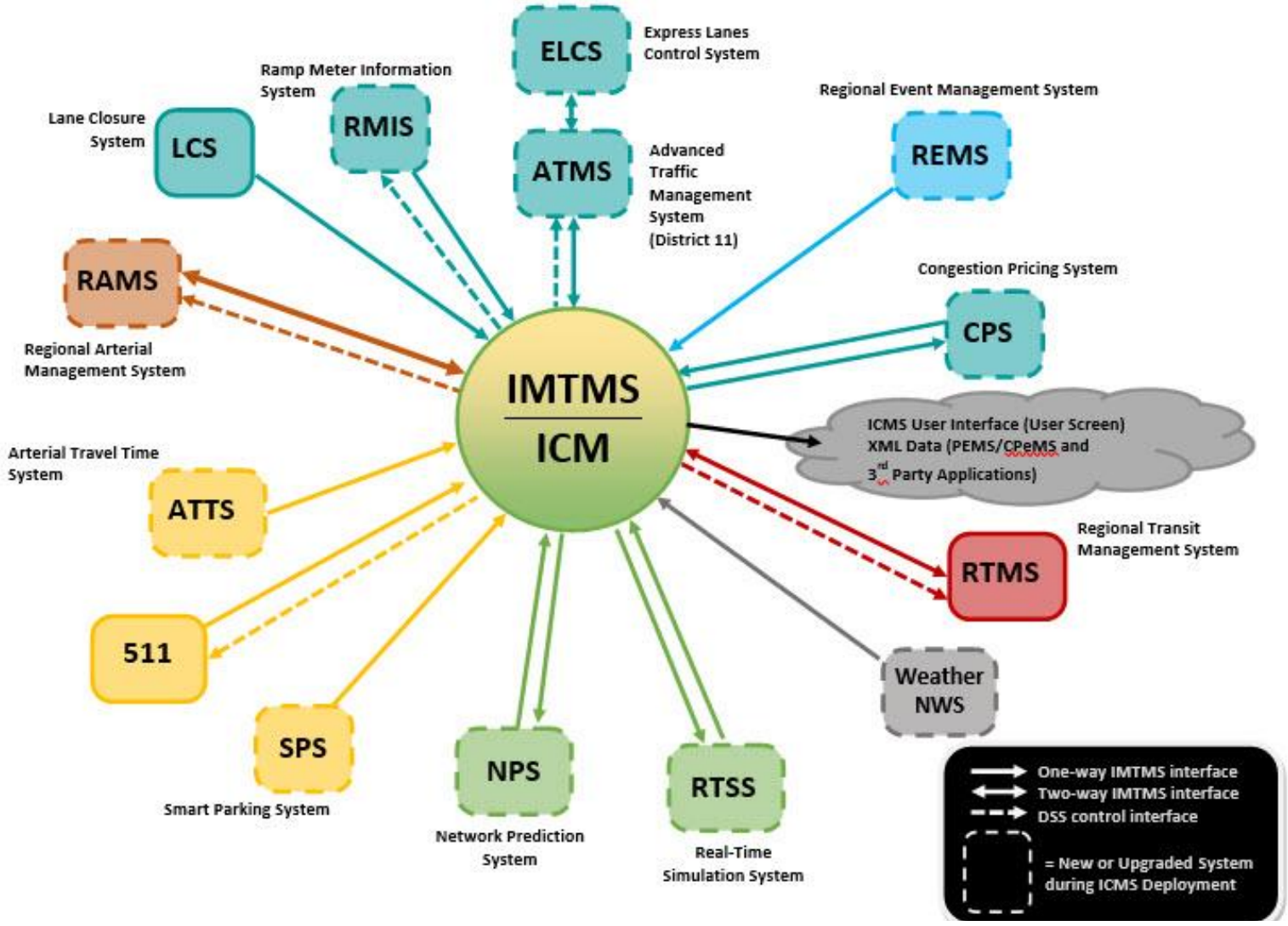
Interagency Agreements

- Essential for ICM and multi-agency operations strategies
- New operations models, potential for joint operations
- Data sharing and system connectivity
- Often, the most complex part of an ICM program and strategy
- Examples – I-80, SANDAG, AZ
  - Operating and operating authority
  - Data sharing parameters
  - Cost sharing
  - Decision making

Real-time Data Sharing to Support ICM

- Regional strategies for sharing data
- What information do partners need?
- Operations data to support ICM
  - Real-time freeway, arterial and transit operations
  - Real-time strategy implementation information
  - Agency notifications
- Overcoming institutional barriers to effective data sharing
  - SANDAG (San Diego/D11)
  - RITIS (I-95)
  - RADS (Arizona)

SANDAG Data Hub



Staffing and Training

- Staff capacity building
  - Current staff vs. supplementing staff
  - Leveraging available regional technical staff resources
- Staff training needs for ICM and next-generation operations
  - New systems and new operational approaches
  - Multi-agency training strategies essential

ICM Resources

- California Connected Corridors
  - http://connected-corridors.berkeley.edu/
- FHWA/USDOT
  - its.dot.gov/icms
  - ICM Knowledge and Technology Transfer (KTT)
  - Guidance documents for each stage – planning, stakeholder engagement, design, test plan, modeling, training, lessons learned
  - Fact sheets

Managing a Corridor Considerations

- What is the status of the current ICM planning efforts in D9?
- What are your initial considerations?
- How would you go about developing a plan for corridor management?
- Who would you involve?
- What technologies/systems/actions would you consider?
- What are the major gaps or challenges you see in implementing the plan?
- What would you do to give your plan the best chance of success, especially considering the gaps/challenges?